Nutrition Knowledge, Rice Prices, and the Micronutritional Impact of Indonesia's Crisis of 1997/98

Prepared for presentation at the International Rice Congress
Beijing, China, September 17, 2002.

Steven A. Block
Tufts University
Medford, MA USA
steven.block@tufts.edu

BAPPENAS/DEPARTMEN PERTANIAN/USAID/DAI FOOD POLICY ADVISORY TEAM

September 2002

This set of working papers were produced through collaboration of Development Alternatives, Inc. (DAI) through support from the Office of Economic Growth, USAID/Indonesia under the terms of Award No. PCE-I-800-99-00002-00 and Helen Keller International (HKI) and the National Institute of Health Research and Development, Ministry of Health through support from the Office of Health, Population and Nutrition, USAID/Indonesia under the terms of Award No. 497-A-00-99-00033-00.

ABSTRACT

This paper addresses three related questions pertaining to child micronutrient status in Indonesia: 1) What was the nutritional impact of Indonesia's economic and financial crisis of 1997/98? 2) What are the determinants of child micronutrient status? 3) What is the effect of rice price increases on household purchases of micronutrient-rich foods? Analysis of household survey data from rural Central Java reveals that Indonesia's financial crisis had relatively little effect on child caloric intake. Families tended to maintain their rice consumption in the face of a tripling of the rice price, but often did so by sacrificing their consumption of higher quality micronutrient-rich foods. As a result, child micronutrient malnutrition (e.g., iron-deficiency anemia) increased substantially even while weight-for-age remained constant. This effect was most pronounced among the youngest cohorts of children at the time of the crisis.

More focused analysis of the determinants of child micronutrient status demonstrates that maternal nutrition knowledge is a critical factor. Indeed, specific knowledge of nutrition is more critical than formal schooling as a determinant of child micronutrient status. Other relevant factors include child gender and age, the number of children in the household, household expenditure levels, and access to water. Yet, establishing a reduced form relationship between maternal nutrition knowledge and child micronutrient outcomes sheds no light on the question of *how* such knowledge affects outcomes. Understanding the mechanisms through which nutrition knowledge works requires a more structural approach.

A production function for child micronutrient status must include intake of micronutrient-rich foods. Yet, underlying such a specification there must also be a demand function for micronutrient-rich foods. Thus, one possible way to understand the mechanisms through which maternal nutrition knowledge affects child micronutrient outcomes is to include nutrition knowledge as an argument in the demand function for micronutrient-rich foods. What is the impact of nutrition knowledge on household budget allocation between food and non-food, and among foods, between starchy staples and micronutrient-rich foods? Preliminary evidence suggests that households of mothers with nutrition knowledge allocate substantially greater budget shares to micronutrient-rich foods and smaller budget shares to rice. The cross-price elasticity between micronutrient consumption and the rice price is key, particularly in the Indonesian crisis context in which baseline rate of child anemia was high and rice prices increased rapidly. Preliminary evidence suggests that the micronutrient consumption of households with nutrition knowledge is substantially less sensitive to changes in rice prices than that of households lacking in nutrition knowledge. This may have been a critical factor in determining the severity with which Indonesia's crisis affected the nutritional welfare of some households relative to others'

Introduction[1]

Indonesia's economic crisis of 1997/98 provides a relatively unique context in which to study the nutritional impact of dramatic increases in the price of rice and other foods. Rice has long been the mainstay of Indonesian diets. Nearly every family consumes at least some rice, and in rural Central Java (the focus of the current study) an average family obtains over half of its calories from rice and devotes to it nearly a quarter of household expenditures. Among the very poor, rice expenditures can account for 40% of total household expenditures. Thus, the tripling of rice prices in Indonesia between January 1997 and October 1998 represented a substantial shock to real income. This shock was compounded by substantial increases in the prices of many other food commodities as well, including high quality foods with high micronutrient content such as meat and dairy, vegetables and fruits (Table 1).

What is striking about the impact of the crisis on child nutrition, however, is that families (on average) managed to maintain their children's gross caloric intake. Yet, it appears that this was often accomplished at the expense of children's micronutrient status, as families coped with the crisis-driven increase in the price of rice by substituting high quality micronutrient-rich foods out of their children's diets. Indeed, recent research (Block, et. al., 2002) suggests that child micronutrient status declined substantially during the height of Indonesia's crisis even while caloric intake remained relatively constant.

This finding leads directly to the question of what characteristics distinguished those households in which the micronutritional impact of the crisis was less severe? The "hidden" nature of foods' micronutrient content suggests that maternal nutrition knowledge may be critical – mothers have to *know* that eggs are rich in iron and vitamin A and that those nutrients are important for child development, because they cannot tell simply by looking. Identifying determinants of the demand for child micronutrient status has potentially far-reaching policy implications, particularly if such relatively approachable variables as maternal nutrition knowledge turn out to be important. Yet, if nutrition

[1] The studies of rural Central Java described in this paper were based on household survey data collected under the direction of Helen Keller International, the Jakarta-based staff of which generously provided access to the data and collaborated in the analysis. The author is grateful to HKI, as well as to USAID/Indonesia for its support through the Food Policy Support Project, and to Peter Timmer for collaboration and feedback on all phases of the work.

knowledge is an important determinant of child micronutrient status, *why* is it so? Through what means might maternal nutrition knowledge lead to improved child micronutrient status? The obvious place to look is at the effect of nutrition knowledge on the demand for micronutrient-rich foods. Yet, in a setting such as rural Central Java, the demand for any food cannot be divorced from the dominant role of rice in household diets and expenditures.

In analyzing the events surrounding Indonesia's crisis, this study thus addresses three broadly related questions:

1) What was the impact of Indonesia's crisis on child nutrition?
2) How important is maternal nutrition knowledge (versus formal schooling) in determining the "demand" for child micronutrient status? and,
3) What are the mechanisms through which nutrition knowledge operates to condition that demand?

I. Child Nutrition During the Crisis

Indonesia's economic crisis resulted not only in widespread macroeconomic devastation, but also in a severe shock to real household income. Friedman and Levinsohn (2001) estimate that the real cost of living approximately doubled for rural families. The consequent effect on poverty, though a subject of ongoing controversy, was also severe. The best estimates suggest that the headcount index of poverty increased from 7% to 20% during the peak of the crisis in 1998 (Suryahadi, et. al., 2000). The impact of these events on child nutrition, however, was more subtle.

Figure 1 tracks changes in mean weight-for-age (WAZ) and weight-for-height (WHZ) z-scores in children under five years old over the course of the crisis.[2] The dates at which these observations occur (along the horizontal axis) reflect the timing of the 14 rounds of household surveys on which the analysis is based. The trend for each of these anthropometric indicators is normalized to zero in the first survey round and each subsequent change is measured relative to that baseline. The period between December

[2] Methedological details for the cohort decomposition underlying the analysis in this section are presented in Block, et. al. (2002).

1996 and July 1998 represents a hiatus in data collection during the period that spans the height of the crisis. The change between those dates thus captures the peak crisis impact on any given indicator.

WAZ is the most commonly used indicator of child nutritional status, and is probably also the least rapidly responsive indicator to changes in diet. It is clear from Figure 1 that child WAZ was essentially unaffected by the crisis. Following a small (though statistically significant) decline in the pre-crisis year, WAZ remained constant throughout the crisis. This suggests that households on average maintained their children's gross caloric intake, despite rapid increases in food prices.[3]

The picture begins to change, however, when we consider WHZ, which is more responsive than WAZ to changes in diet. Figure 1 superimposes the time trend in mean WHZ over the trend for WAZ. The trend for WHZ reveals a more negative picture of the effect of the crisis on child nutrition. In this case, mean WHZ declined by over one-third of a standard deviation during the height of the crisis (between December 1996 and July 1998). This change is both statistically and biologically significant, reflecting an increase in the prevalence of wasting, which doubled from 6% to 12% of children during that period.[4]

Blood hemoglobin concentration provides a yet more revealing picture of crisis impacts -- one that reveals effects on dietary *quality* in addition to quantity, and serious shortfalls have been associated with heightened mortality and reduced learning capacity. The peak crisis period in Indonesia was accompanied by substantial declines in household consumption of eggs and dark green leafy vegetables -- foods that are important sources of iron and other micronutrients. Decomposing trends in children's hemoglobin concentration reflects the expected consequence for micronutrient status. Indeed, the share of children in rural Java vulnerable to iron deficiency anemia is substantial. Anemia is characterized by a hemoglobin concentration (Hb) of less than 11 g/dL of blood (WHO, UNICEF, UNU,98). Mean Hb in

[3] There is anecdotal evidence that this was accomplished, in part, by mothers diverting their own rice consumption to their children during the crisis. See the series of crisis bulletins by Helen Keller International.
[4] Wasting is defined as being beyond 2 standard deviations below the international mean of weight-for-height.

children in rural Central Java was 11.02 g/dL, and the prevalence of anemia among children over the entire sample period was 47 percent.[5]

Figure 2 shows the time path of child Hb (in logarithms) over the course of the crisis. The decline in mean child hemoglobin concentration from December 1996 to July 1998 was 6.1% (or 0.32% per month). In absolute terms, this corresponds to a decline of 0.68 g/dL over the entire period, which is greater than one standard deviation for the full sample of those cohorts. The time effects (slope) are statistically significant, as are the differences in levels between December 1996 and July 1998. This decline represents an increase in the prevalence of anemia from its baseline of nearly 50% to over 70% over that period. While it is difficult to explain the peak in December 1998, average child Hb tended to stabilize at a post-April 1999 average that was 0.5 g/dL lower than the level in the initial survey round (joint F-score = 16.89). Further analysis reveals that the decline in child Hb was increasingly severe for progressively younger cohorts at the onset of the crisis. Indeed, the most severe reductions in child Hb, measured during the critical developmental age of 6 to 18 months, was found among those cohorts that were *conceived* during the height of the crisis.[6]

Indonesia's macroeconomic crisis thus had substantial microeconomic (even microscopic) effects. Families sacrificed to maintain their children's caloric intake (e.g., rice consumption); yet, under the circumstances something had to give, and what gave was consumption of high quality micronutrient-rich foods. This choice is reflected in substantial increases in the prevalence of iron deficiency anemia among children in rural Central Java during the peak crisis months. This finding speaks to a broader issue.

II. Nutrition Knowledge, Schooling, and Child Micronutrient Status

The debilitating, pervasive, and potentially fatal consequences of micronutrient malnutrition – or "hidden hunger" – are an increasing priority for public health officials in developing countries; yet,

[5] In the absence of other causes of anemia (hookworm, malaria), the main cause of anemia is iron deficiency. Anemia is the final stage in the development of iron deficiency and the prevalence of anemia suggests a much larger proportion of children, as many as twice, are likely to suffer from iron deficiency (though not with sufficient severity to qualify as anemia).
[6] See Block, et. al. (2002) for details of the cohort analysis.

economists have rarely addressed analysis of micronutrient demand and the determinants of micronutrient status.[7]

The extent to which micronutrient malnutrition is automatically ameliorated by income growth is unclear. Several studies have asserted that expenditure elasticities for *nutrients* may be close to zero, despite significantly higher expenditure elasticities for *food* as a result of consumer preferences for higher quality calories as income rises.[8] The implications of such substitution, particularly substitution towards red meat, are potentially positive with respect to iron deficiency anemia. Yet, substitution to meat typically occurs at relatively high levels of income, and may thus be too remote a solution for those at the lower end of the expenditure distribution.

Thus, the search for other key determinants of child micronutrient status is critical. Maternal education, in particular, has played a central role in empirical studies of the demand for child health (almost universally defined by height-for-age). Many studies have found a strong positive association between maternal education and child height-for-age.[9] Yet, the "hidden" quality of micronutrient content in food suggests that improved intake of micronutrient-rich foods may depend importantly on consumers' nutrition knowledge in particular. Indeed, it is especially relevant to know whether maternal nutrition knowledge dominates formal schooling as a determinant of child micronutrient status. Evidence from rural Central Java indicates that it does.[10]

Figures 3 and 4 illustrate this point non-parametrically. Figure 3 traces the relationship between child hemoglobin concentration and real household expenditures per adult equivalent, distinguishing between the children of mothers with and without nutrition knowledge.[11] The results suggest that at every

---

[7] Exceptions include Bouis (1991), Bouis and Novenario-Reese (1997), Pitt and Rosenzweig (1985), Behrman and Deolalikar (1987).
[8] Behrman and Deolalikar, 1987; Behrman and Wolfe, 1984; Pitt and Rosenzweig, 1985; Bouis and Haddad,1992; Subramanian and Deaton, 1996).
[9] Behrman and Wolfe (1984, 1987), Barrera (1990), Alderman and Garcia (1994), Lavy, et.al. (1996), among others.
[10] This evidence is presented in full detail in Block (2002a).
[11] The definition of nutrition knowledge adopted for this analysis is based on mothers' knowledge of the benefits of vitamin A-rich foods for their children. Mothers were asked to list those benefits of which they were aware. There were nine predetermined correct answers. The survey data include for each respondent whether or not she

level of per capita expenditure, mothers with nutrition knowledge demand greater micronutrient status in their children than do mothers without nutrition knowledge. At the sample median, the margin is approximately 0.4 g/dL – an increase sufficient to raise nearly 25% of anemic children in the sample to the 11.0 g/dL cutoff for anemia. The difference between outcomes for those with and without nutrition knowledge is not a function of expenditure levels, and the confidence intervals do not over lap for the middle eight deciles of the expenditure distribution. This analysis potentially confounds the effects of nutrition knowledge and formal schooling (which may be related). However, even when this analysis is repeated for a sample limited to mothers with secondary education, the point estimates for the nutrition knowledge group lie above those for the non-knowledge group for all expenditure levels above the 10th percentile. In that case, however, the extent of the difference is reduced and the separation of the 95% confidence intervals is less clear in some portions of the distribution.

In contrast, Figure 4 illustrates that when the sample is split between children of mothers with and without secondary education, the differences are minimal and not statistically significant even when the analysis is unconditional on nutrition knowledge. Limiting the sample used in Figure 4 to children of mothers with nutrition knowledge eliminates any marginal benefit from formal schooling.

These non-parametric relationships, even with sample splits, are inherently limited in their dimensionality. More traditional regression analysis is still necessary to fill out the picture. The regression results presented in Table 2 clarify and extend this preliminary evidence on the critical role of nutrition knowledge in determining child micronutrient outcomes. The key results pertain to the estimates for maternal schooling and nutrition knowledge (now measured as a continuous variable). The first three specifications include child and household characteristics, but exclude community characteristics. The effect of maternal schooling on child Hb is positive and significant when it enters the specification without nutrition knowledge (column 1). The same is true for nutrition knowledge, when it

---

mentioned each of the nine correct answers. To construct the nutrition knowledge proxy, I count for each respondent the proportion of correct answers given from among the nine possibilities. To split the sample, as in Figure 3, two or more correct answers are required to be said to have nutrition knowledge. This accounts for approximately 13% of mothers sampled.

enters the specification without schooling (column 2). When both explanatory variables enter together, both remain significant, though the point estimate and statistical significance of schooling declines. This is consistent with the interpretation that schooling's contribution in part lies through its effect on nutrition knowledge.

Adding community characteristics to the remaining specifications, however, undermines the explanatory power of schooling while leaving unchanged the effect of nutrition knowledge. Schooling survives marginally in the fully specified OLS estimate (column 4). Yet, when the potential for endogeneity and measurement error in expenditures and nutrition knowledge are addressed via two-stage least squares in the remaining specifications (columns 5-8), maternal schooling effectively drops out of the model while the estimated effect of nutrition knowledge proves robust.[12]

While these results establish a reasonably strong reduced form relationship between maternal nutrition knowledge and child micronutrient outcomes (proxied by hemoglobin concentrations), they shed no light on the *mechanisms* through which nutrition knowledge operates to produce those outcomes.

The consumption of iron-rich foods is clearly critical to hemoglobin concentration (Bhargava, Bouis, and Scrimshaw, 2001). Thus, the logical place for an economist to look for a mechanism through which nutrition knowledge contributes to child micronutrient status is in its effect on the allocation of household expenditures and on demand parameters. Does maternal nutrition knowledge condition these parameters?

III. The Effect of Nutrition Knowledge on Food Budget Allocation and Demand

Once again combining non-parametric and traditional regression analysis, we find evidence that maternal nutrition knowledge strongly conditions the allocation of household food expenditures as well as the underlying demand parameters.[13] The household survey data from rural Central Java show that

[12] Note, as well, that male children have lower Hb concentrations than females, that food prices appear to add little explanatory power, and that child Hb in general declines with greater household distance to water and with each additional child under 6 years old in the household.
[13] Detailed results are provided in Block (2002b).

households with and without nutrition knowledge do not differ in their total food budget share (as a function of income).[14] Households at the 10th percentile of per capita expenditure allocate approximately 75% of total expenditures to food; this budget share falls to 60% at the 90th percentile of expenditures. Yet, the allocation of those similar food budgets differs considerably between the "knowledge" and "non-knowledge" households.

Figure 5 traces the share of food budgets allocated to micronutrient-rich foods as a function of real expenditures per adult equivalent, distinguishing between households with and without nutrition knowledge.[15] It is clear that households of mothers with nutrition knowledge devote larger shares of their food budget to micronutrient-rich foods. This difference is a declining function of per capita expenditures, but is large at the lower end of the distribution, and remains statistically significant (as indicated by the 95 percent confidence intervals) throughout the distribution. It is also clear that nutrition knowledge substitutes for income in driving the demand for micronutrient-rich foods: the mean budget share for the knowledge group at the 10th percentile of the expenditure distribution is not attained by the non-knowledge group until they reach the sample median expenditure level.[16]

A second dimension of demand that is apparent in Figure 5 is the income elasticity of demand. If the budget share was a flat function of log expenditures, the implied income elasticity would equal unity. However, it is well-established that the income elasticity of demand for the types of high quality foods included in the micronutrient aggregate is greater than unity, and this is reflected in the positive slopes of the budget share paths. The positive slope of these budget share paths thus indicates that micronutrient-rich foods are a luxury for both groups. Yet, the tendency for the budget share paths of these two groups

---

[14] The criteria used to define nutrition knowledge in this section differs from that used in the previous section. I now define nutrition knowledge by whether or not mothers knew the appropriate age at which to introduce complementary feeding foods to their infants. This is a lower hurdle than applied in the case of knowledge of vitamin A. Approximately 55% of mothers knew the appropriate age (i.e., 4 months).

[15] "Micronutrient-rich foods" is taken here as a composite of beef, chicken, vegetables, milk, eggs, fruit, and fish. Block 2002b provides a similar analysis for eggs in particular.

[16] As in Figure 3, the apparent effect of nutrition knowledge in Figure 5 may be confounded with the effect of formal schooling. Yet, even more than before, limiting the sample to mothers with secondary education leaves the picture in Figure 5 largely unchanged.

to converge as expenditures increase (e.g., the steeper rate of incline for the non-knowledge group) implies a higher income elasticity of demand for those households lacking in nutrition knowledge.

If households with nutrition knowledge allocate substantially larger shares of their food budgets to micronutrient-rich foods while their total food budget share is not different from that of non-knowledge households, then what is it that the knowledge households are *not* buying as intensively? The answer is rice.

Figure 6 traces the share of food budgets for these groups allocated to rice. The result is virtually a mirror image of the micronutrient case. Households lacking in nutrition knowledge allocate substantially larger food budget shares to rice throughout the expenditure distribution. As in the previous case, these statistically and economically significant differences are a declining function of expenditures. This is a particularly striking result in the context of Indonesia's dominant rice economy. The difference in rice shares of the food budget between the knowledge and non-knowledge groups accounts for essentially the entire difference in budget allocations to micronutrient-rich foods. Rice shares of the food budget are a declining function of per capita expenditures for both groups, but as before, the share for the non-knowledge group at the sample median expenditure is attained by the knowledge group at the 10th percentile of the expenditure distribution.[17]

These results have direct implications for understanding the impact of the Indonesian economic crisis on child nutrition. Recall from Section I that the most severe impact was not on gross caloric (e.g., rice) intake, but rather on the consumption of micronutrient-rich foods. The crisis-driven decline in child hemoglobin concentrations (Figure 2) reflects changes in mean over time. Yet, this implies that some children were more severely affected than the mean, and others less so. What are the household characteristics associated with different outcomes? The results presented in Section II establish a relationship between maternal nutrition knowledge and child hemoglobin outcomes, and the results of this Section suggest that it is through its effect in conditioning food budget allocations and demand parameters

[17] These results, too, are unaffected by limiting the sample to households of mothers with secondary education.

that nutrition knowledge works to contribute to improved micronutritional outcomes. These issues are of primary importance in a context in which the poorest families allocate 75% of the total income to food, 40% of their total income to rice, and in which rice prices tripled over a period of 18 months.

The ability to cope with rapidly rising staple food prices may be the central benefit of nutrition knowledge in the context of Indonesia's crisis. The cross-price elasticity of demand between micronutrient-rich foods and rice thus becomes a central concern. Estimation of a demand function for micronutrient-rich food yields point estimates for the income elasticity, along with the own- and cross-price elasticities of demand.[18] Does nutrition knowledge alter these parameters? The results presented in Table 3 indicate the following: knowledge and non-knowledge households do not differ statistically in their own-price elasticity of demand for micronutrient-rich food; yet, as suggested in Figure 5, the income elasticity of demand is greater for the non-knowledge households.

The most striking difference between knowledge and non-knowledge households, however, is precisely in the sensitivity of their micronutrient expenditures to increases in the price of rice. Various approaches to estimating those parameters yield essentially the same result: households without nutrition knowledge significantly reduce their expenditures on micronutrient-rich food when rice prices increase, while households with nutrition knowledge do not change their micronutrient expenditures as a function of rice prices. These differences between household types are statistically significant in 3 of the 4 specifications presented in Table 3. Block (2002b) presents similar evidence specifically for eggs (the best single proxy for micronutrient-rich foods).

IV. Conclusion

Additional results from the estimation of demand functions suggest that maternal schooling and having fewer children under 6 also increase households' food budget allocations towards high-quality foods. Yet, these additional findings provide little basis for public policy to promote child micronutrient

[18] Full results for the estimation of demand functions, as well as additional non-parametric results, are presented in Block, 2002b.

status. Delivering formal education is difficult and expensive, often more so when targeted towards women, and most countries are already maximizing their efforts in that direction. Similarly, public policies oriented towards reducing fertility are both difficult to implement and highly controversial. However, the findings presented in this study suggest the availability of a relatively simple and powerful approach. Household resource allocation, as conditioned by elasticities of expenditure and price, is a pervasive economic force. The present findings demonstrate that maternal nutrition knowledge shapes household food demand parameters and budget allocations in predictable, positive, and policy relevant ways. By that means, maternal nutrition knowledge contributes to improved child micronutrient status. This may well explain critical differences across households in the nutritional impact of Indonesia's economic crisis.

Maternal nutrition education may also have a substantial macroeconomic payoff, given the cognitive and labor productivity losses estimated specifically for iron deficiency. The results presented above provide the basis for crude approximations. Using an accounting approach developed by Ross and Horton (1998), the baseline 50% prevalence of child anemia in rural Central Java (if it is broadly representative of Indonesia) costs $32.52 per capita loss of GDP (in 1999 PPP dollars), or approximately $6.73 billion (1.33% of GDP). Increasing real per adult equivalent household expenditures by one standard deviation would (based on the coefficients estimated in Table 2 column 8) reduce the per capita loss to anemia by $1.95, a savings of nearly $404 million. However, a one standard deviation increase in the proportion of mothers having nutrition knowledge (as defined in Section II) would save $5.85 per capita, or $1.2 billion in lost national income (nearly a quarter of one percent of total GDP in 1999 PPP dollars).[19] The prospects for a one standard deviation increase in maternal nutrition knowledge may be

---

[19] These calculations are based on the formula of Ross and Horton (1998), who estimate that cognitive loss from iron deficiency = 4% *x* wage share of GDP *x* GDP/capita *x* Prevalence of child anemia. Four percent is the empirically-derived loss in labor productivity. I make the extremely crude assumptions that the labor share of Indonesia's GDP is 2/3 (a figure in line with recent estimates (not for Indonesia) by Gollin, 2002) and that the prevalence of child anemia in rural central Java is nationally representative. The change in anemia prevalence among children is calculated by shifting the cumulative distribution function of child hemoglobin concentration by an amount equal to the hypothesized change in the explanatory variable times its point estimate from Table 2

low in the short run, but it is surely a more attainable goal than a similar increase in per capita income, and one with three times the benefit in saved GDP. This points strongly towards the importance of public efforts to promote specific nutrition knowledge of mothers.

These figures represent only crude orders of magnitude. Yet, benefits on this order of magnitude suggest that nutrition education programs may provide a relatively cost effective and tractable vehicle through which governments can promote child micronutrient status. Such benefits are likely to compare favorably with many alternative uses of public investment funds, to say nothing of the resulting improvements in the quality of life and income earning prospects of the poor.

---

column 8. Calculations are based on a 1999 population of 207 million and a GDP of $505 billion in 1999 PPP dollars.

References

Alderman, H and M. Garcia, 1994. "Food Security and Health Security: Explaining the Levels of Nutrition Status in Pakistan," *Economic Development and Cultural Change*, 42-3:485-507.

Barrera, A. 1990. "The Role of Maternal Schooling and its Interaction with Public Health Programs in Child Health Production," *Journal of Development Economics* 32:69-91.

Behrman, J. and A. Deolalikar, 1988. "Health and Nutrition," in Chenery and Srinivasan, eds., *Handbook of Development Economics*, Vol. 1. Amsterdam:North-Holland Press.

Behrman, J. and B. Wolfe, 1984. "More Evidence on Nutrition Demand: Income Seems Overrated and Women's Schooling Underemphasized," *Journal of Development Economics* 14(1-2): 105-128.

Behrman, J. and B. Wolfe, 1987. "How Does Mother's Schooling Affect the Family's Health, Nutrition, Medical Care Usage, and Household Sanitation?' *Journal of Development Economics* 27(1-2): 395-420.

Bhargava, A., H. Bouis, and N. Scrimshaw, 2001. "Dietary Intakes and Socioeconomic Factors are Associated with the Hemoglobin Concentration of Bangladeshi Women," *Journal of Nutrition* 131:758-764.

Block, S. (2002a). "Nutrition Knowledge Versus Schooling in the Demand for Child Micronutrient Status," Working Paper No. 93, Center for International Development, Harvard University: Cambridge, MA.

_____ (2002b). "Why Does Maternal Nutrition Knowledge Affect Child Micronutrient Status? Parametric and Non-Parametric Evidence on the Demand for Micronutrient-Rich Foods," mimeo, Fletcher School, Tufts University, Medford, MA .

_____, et. al., 2002. "Did Indonesia's Crises of 1997/98 Affect Child Nutrition? A Cohort Decomposition Analysis of National Nutrition Surveillance Data," Working Paper No. 90, Center for International Development, Harvard University: Cambridge, MA.

Bouis, H. and Novenario-Reese, "The Demand for Micronutrients in Bangladesh," mimeo, International Food Policy Research Institute: Washington, D.C., 1997.

Chernichovsky, D. and O.A. Meesook, 1984, "Patterns of Food Consumption and Nutrition in Indonesia," World Bank Staff Working Paper No. 670. Washington, D.C.: World Bank.

Friedman, Jed, and James Levinsohn, "The Distributional Impact of Indonesia's Financial Crisis on Household Welfare: A "Rapid Response" Methodology," NBER Working Paper No. 8564, (2001).

Gollin, D. "Getting Income Shares Right," *Journal of Political Economy*. Volume 110, Number 2:

Helen Keller International/Indonesia. Nutrition and Health Surveillance System (NSS). Monitoring the Economic Crisis: Impact and Transition, 1998-2000, Jakarta, Indonesia, November, 2000, pg 45-48.

Lavy, V., J. Strauss, and P. de Vreyer, 1996. "Quality of Health Care, Survival, and Health Outcomes in Ghana," *Journal of Health Economics*, 15:333-357.

Ross, J and S. Horton, 1998. "The Economic Consequences of Iron Deficiency," The micronutrient Initiative: Ottawa, CA.

Suryahadi, Asep, Sudarno Sumarto, Yusuf Suharso, and Lant Pritchett, “The Evolution of Poverty during the Crisis in Indonesia, 1996 to 1999 (Using Full Susenas Sample),” mimeo, Social Monitoring & Early Response Unit, Government of Indonesia.

WFP (World Food Programme). 2001. Food and Nutrition Handbook. Rome.

WHO (World Health Organization). 2000. The Management of Nutrition in Major Emergencies. Geneva.

WHO Expert Committee. Physical Status: The use and interpretation of anthropometry.

WHO Technical Report Series 854. Geneva, 1995.

WHO, *Report of the Commission on Macroeconomics and Health*. Geneva: WHO. (2002).

WHO, UNICEF, UNU (1998): Iron deficiency anemia: prevention, assessment and control. In *Report of a joint WHO/UNICEF/UNU consultation*. Geneva.

Table 1. Price Changes for Selected Foods, January 1997 to October 1998

	Mean Price Increase	Standard Deviation
Rice	195.2%	29.2
Other cereals & tubers	137.5%	101.8
Fish	89.1%	67.4
Meat	97.0%	49.3
Dairy & eggs	117.1%	31.9
Vegetables	200.3%	129.5
Pulses, tofu, & tempeh	95.2%	76.0
Fruit	103.7%	61.3
Oils	122.0%	74.8
Sugar, coffee, & tea	142.9%	28.3
Prepared food & beverages	81.4%	51.7

Source: Friedman and Levinsohn (2001) based on their analysis of SUSENAS and BPS surveys of urban markets in 27 provinces.

Table 2. Parametric Estimation of the Conditional Demand for Child Micronutrient Status[a] (Dependent variable: child hemoglobin concentration)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Estimator	OLS	OLS	OLS	OLS	2SLS[d]	2SLS[f]	2SLS[d]	2SLS[g]
Child Characteristics								
Gender	-0.116***	-0.116***	-0.115***	-0.113***	-0.119***	-.110***	-0.120***	-0.118***
(1=male)	(0.039)[c]	(0.039)	(0.039)	(0.039)	(0.040)	(0.038)	(0.040)	(0.039)
Age (months)	-0.034***	-0.035***	-0.035***	-0.033***	-0.033***	-0.035***	-0.033***	-0.035***
	(0.019)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Age squared	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Age cubed	-.00003***	-0.00003***	-0.00003***	-0.00003***	-0.00003***	-0.00003***	-0.00003***	-0.00003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Community Characteristics								
Tapwater (nslf)[b]				0.113	0.059	0.014	0.083	-0.046
				(0.222)	(0.229)	(0.205)	(0.234)	(0.217)
Waste System (nslf)				-0.067	-0.044	-0.109	-0.036	-0.081
				(0.411)	(0.412)	(0.439)	(0.406)	(0.436)
Distance to water				-0.001**	-0.001**	-0.001**	-0.001**	-0.001**
(nslf)				(0.0004)	(0.0005)	(0.0004)	(0.0005)	(0.0004)
Log price eggs				-0.391	-0.415	-0.425	-0.407	-0.453
				(0.386)	(0.382)	(0.398)	(0.382)	(0.391)
Log price chicken				0.168**	0.175**	0.116	0.187***	0.126
				(0.083)	(0.085)	(0.080)	(0.086)	(0.081)
Log price rice				0.257	0.201	0.440	0.162	0.366
				(0.320)	(0.323)	(0.332)	(0.326)	(0.330)
Log price beef				-0.010	-0.013	-0.017	-0.012	-0.020
				(0.029)	(0.030)	(0.030)	(0.030)	(0.030)
Log price fish				0.031	0.036	0.049	0.032	0.054
				(0.044)	(0.046)	(0.045)	(0.046)	(0.047)
Household Characteristics								
No. Children Under	-0.152***	***-0.150******	-0.145***	-0.138***	-0.137***	-0.112**	-0.143***	-0.112**
6	(0.049)	(0.049)	(0.049)	(0.039)	(0.040)	(0.044)	(0.040)	(0.045)
Maternal Schooling	0.025***		0.018**	0.015*	0.009	-0.012	0.016*	-0.018
	(0.007)		(0.007)	(0.008)	(0.009)	(0.020)	(0.008)	(0.021)
Maternal		1.105***	0.872***	0.821***	0.786***	4.331*		4.157*
Nutri.Know.		(0.280)	(0.296)	(0.281)	(0.276)	(2.443)		(2.317)
Expenditure per	0.066	0.082*	0.062	0.069	0.294**	0.054	0.290**	0.321**
Adult Equivalent	(0.048)	(0.048)	(0.048)	(0.048)	(0.126)	(0.051)	(0.127)	(0.131)
R^2	0.238	0.239	0.240	0.245	0.240	0.211	0.238	0.207
Obs	3134	3134	3134	3134	3134	3134	3134	3134
Sargan Test					0.754[e]	0.264	0.707	0.509

*** = significant at .01-level, ** = significant at .05-level, * = significant at .10-level.

a. All specifications include dummy variables (results omitted) for the six ecological zones included in the sample and for survey round.
b. "nslf" indicates village average excluding household *i* for each *i*.
c. Robust standard errors, corrected for clustering at the village level.
d. Endogenous variable: expenditures; Instruments: number of cows owned, previous year's income from remittances, number of children sleeping in a single room, size of house per adult equivalent (and, for efficiency, all other included exogenous variables).
e. P-value from Sargan test of overidentifying restrictions. H_0: instruments are valid.
f. Endogenous variable: maternal nutrition knowledge; Instruments: non-self village average of proportion of mothers who had heard of vitamin A-rich foods, non-self village average of maternal years of schooling, non-self village average distance in minutes to health center, village proportion of mothers whose source of nutrition knowledge was health worker, village proportion of mothers whose source of nutrition knowledge was school, maternal age, maternal age squared, maternal height.
g. Endogenous variables: expenditures, maternal nutrition knowledge; Instruments: combined list from (d) and (f).

Table 3. Derived Elasticities of Demand for Micronutrient-Rich Foods[a]

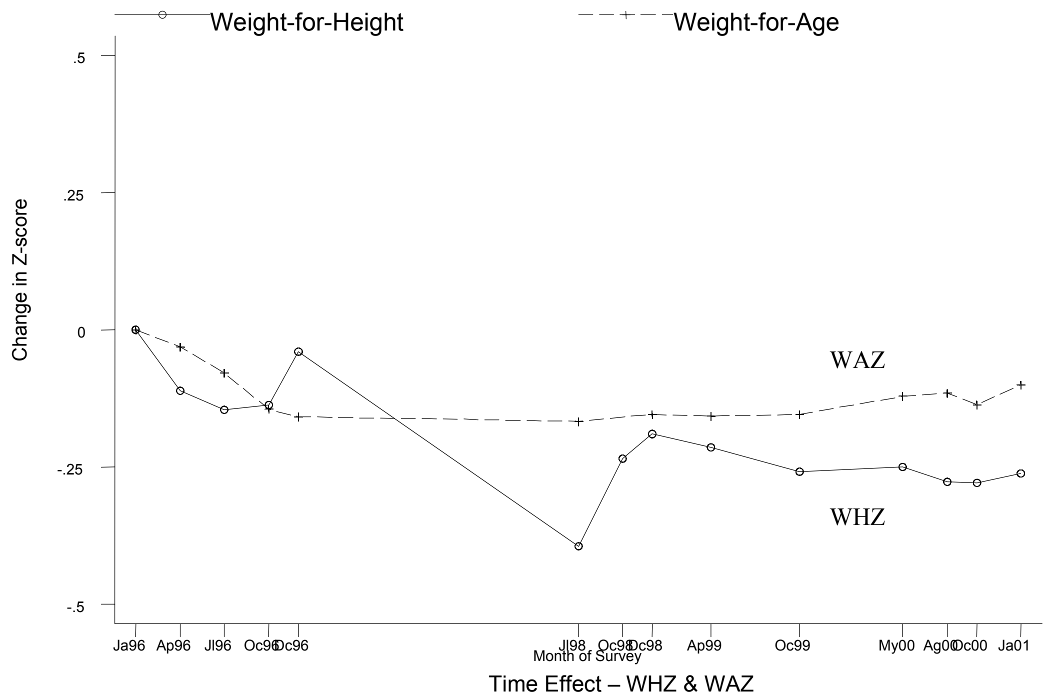
	(1)	(2)	(3)	(4)
Dependent Variable:	Budget Share MN-Rich Foods[b]		Log PCE MN-Rich Foods	
Estimator:	OLS	2SLS	OLS	2SLS
Households with nutrition knowledge				
Own-Price	-1.02***	-1.25***	-0.690***	-0.751***
Cross-Price rice	0.034	0.334	0.014	0.330
Expenditure	0.970***	0.865***	1.076***	0.987***
Households without nutrition knowledge				
Own-Price	-1.055***	-0.814***	-0.691***	-0.677***
Cross-Price rice	0.052	-0.866***	-0.131*	-0.975**
Expenditure	1.058***	1.515***	1.181***	1.572***
Tests for Differences Between Households With & Without Nutrition Knowledge				
Chow Test for Own-Price[c]	0.147	0.009***	0.990	0.752
Chow Test for Cross-Price	0.780	0.021***	0.030**	0.039**
Chow Test for Expenditure	0.000***	0.0003***	0.000***	0.004***

***=significant at the .01-level; **=significant at the .05-level; *=significant at the .10-level

a. Based on coefficient estimates from Table 2.

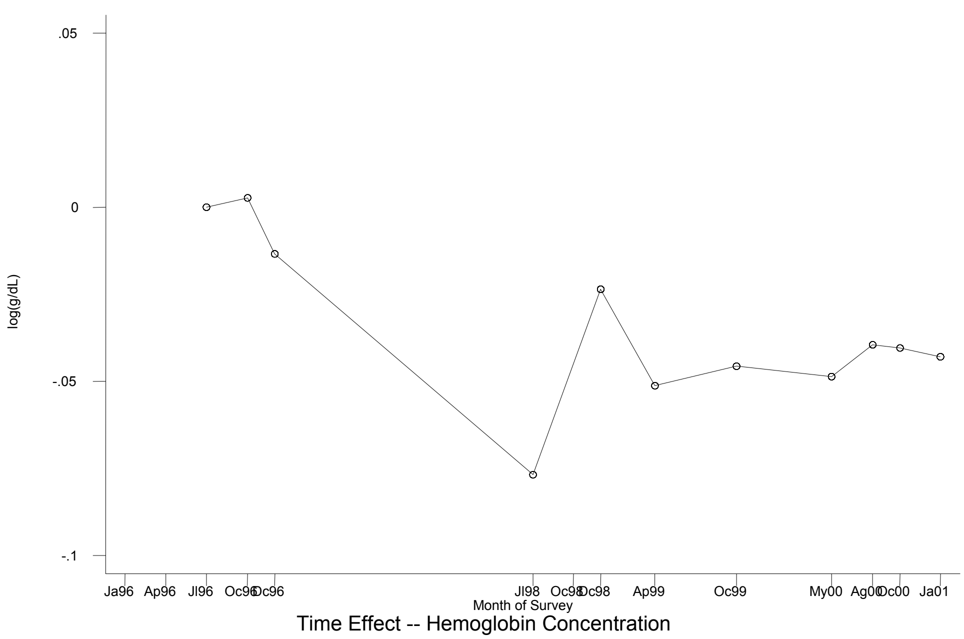
b. Elasticities are calculated at the sample mean budget shares.

c. Chow test (P-value) of H_0: equal elasticities for know & not know households.



Initial (Jan. 1996) levels: WAZ = -0.86; WHZ = -0.01

Figure 1. Relative Changes Over Time in Child Weight-for-Age and Weight-for-Height



Initial (Jul. 1996) absolute mean Hb = 10.98g/dL

Figure 2. Relative Changes Over Time in Child Blood Hemoglobin Concentration

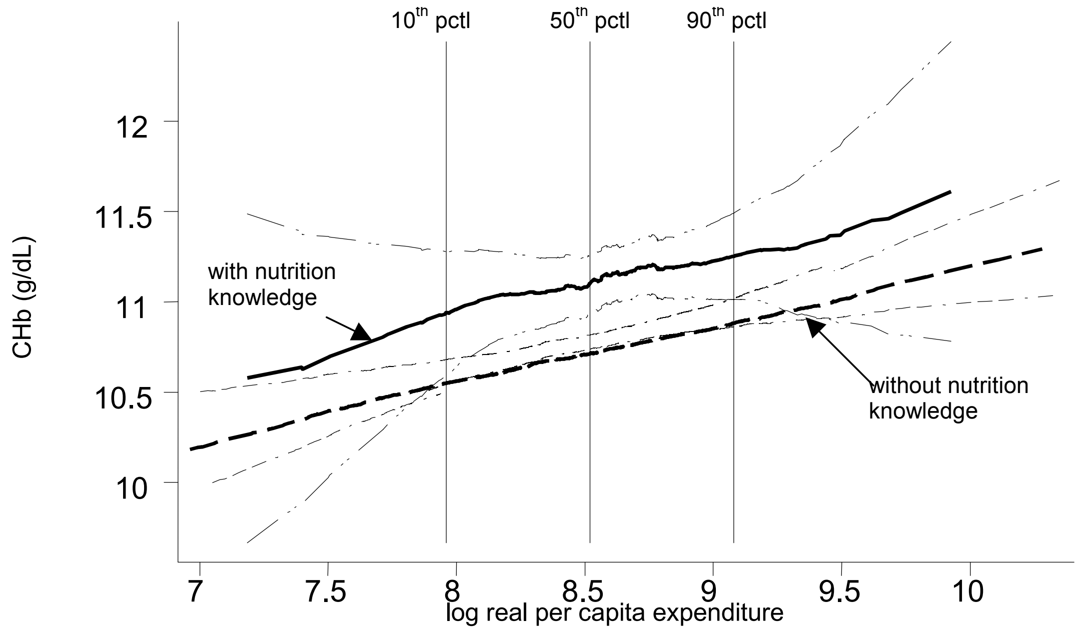


Figure 3. The effect of nutrition knowledge on child Hb, conditional on household expenditures

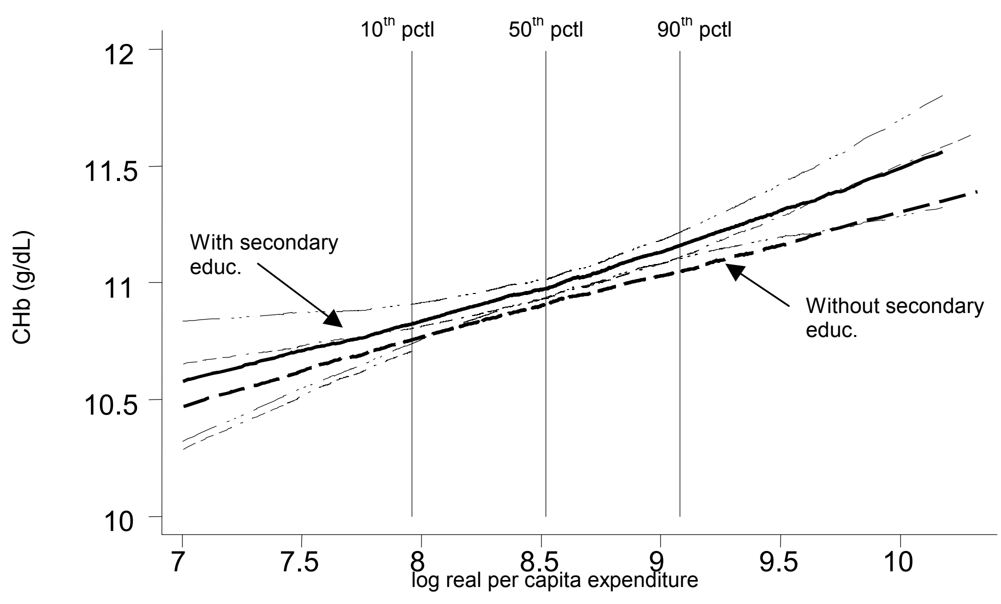


Figure 4. The effect of maternal schooling in child Hb, conditional on household expenditures

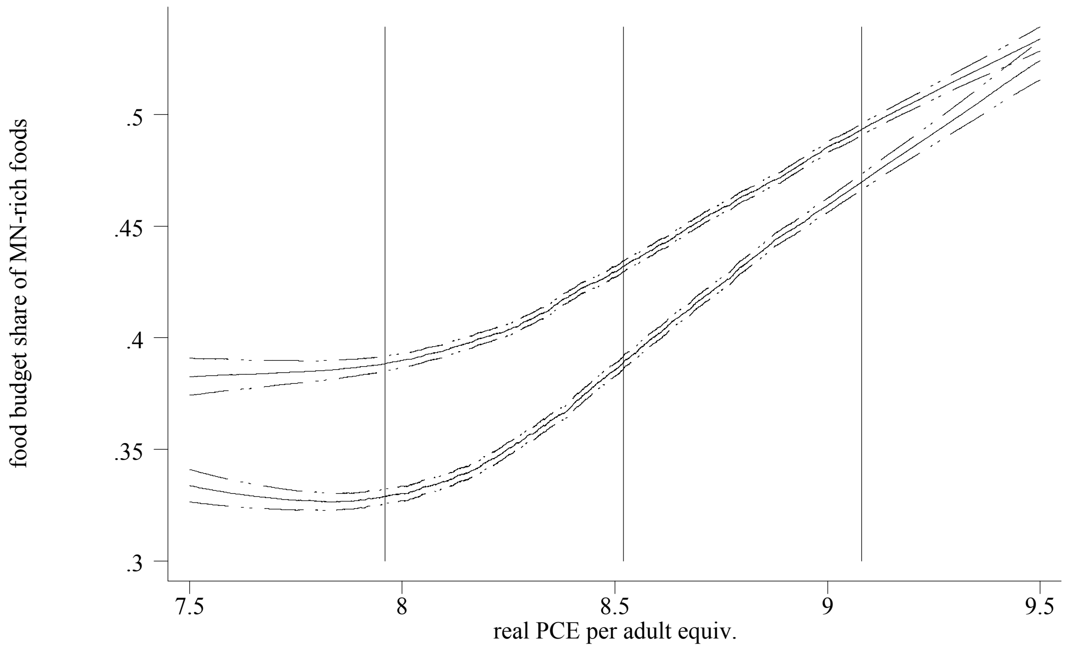


Figure 5. Share of micronutrient-rich foods in household food budgets, conditional on expenditures. (*NB: the nutrition knowledge households are traced in the higher path.*)

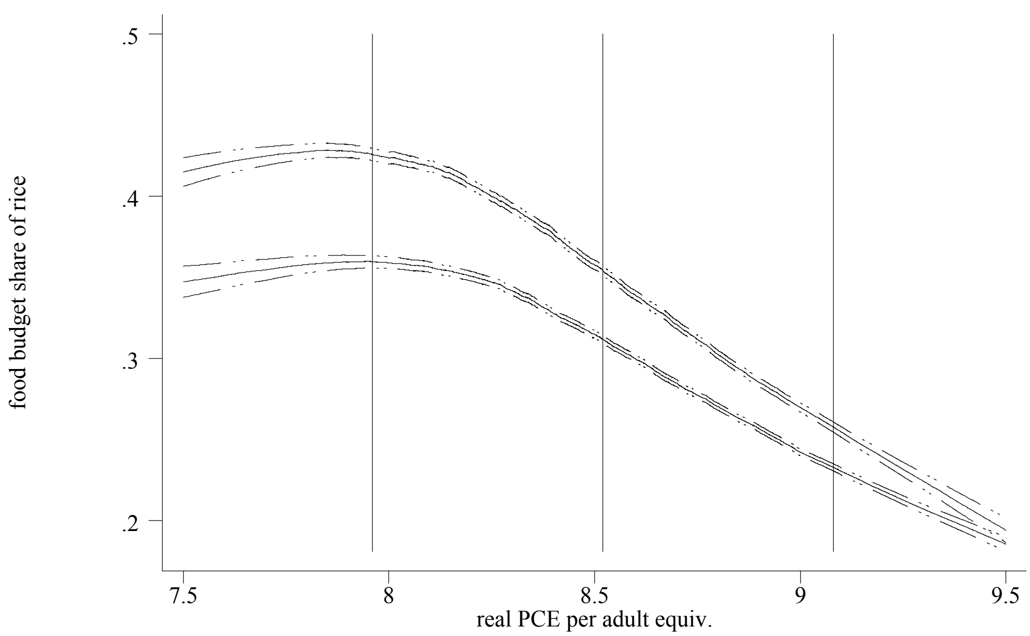


Figure 6. Share of rice in household food budgets, conditional on expenditures. (*NB: the nutrition knowledge households are traced in the lower path.*)